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A Dynamic Approach to the Study of Conservation

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There is a growing consciousness[1] of the need for more effective learning on the part of our citizens of the problems of wise use of our country's resources. We need to recognize that in the field of conservation we must "achieve a greater breadth of vision."

To meet this need, as expressed editorially[2] in Nature Magazine over the last several years, we have planned and are conducting an effective Conservation unit as an integral part of our Biology course. This unit has been entered into enthusiastically by the students. The results have been encouraging and gratifying to teacher and students alike. Our unit is based on the following premises:

(1) that the use and conservation of our natural resources are problems facing *all* the people, and are not of concern merely to certain individuals—that natural resources are of importance from the local, national, and international points of view;
(2) that we, as citizens, have a moral and economic responsibility to future generations which we cannot shirk;
(3) that, since the solution of these problems lies in *group cooperation* and in group recognition, we best can study the problems of conservation by working in cooperation with each other.

We believe that problems concerning people as a group can be worked out more effectively and with greater value to the student by group activities and group discussions than by individual effort. Hence we present this subject of conservation as a *group* problem, wherein the students first learn for themselves and then become responsible for imparting their knowledge to the others.

After an introduction to the subject by the teacher and a general outline of the principle of conservation, we subdivide the topic into the wise use of (1)

[1] MOYANO, SYLVIA M. We Need a New Type of Conservation Education, *The American Biology Teacher*, Vol. 8, No. 4, 1946.
KRIBEL, RALPH M. Our Land And Our Living, *School Science and Mathematics*, Vol. XLVI, No. 401, March 1946.
[2] PACK, ARTHUR NEWTON, President *The American Nature Association.*

soil, (2) forests, (3) water, (4) oil and minerals, (5) wild life, (6) human resources, (7) recreation areas.

Leaders are then appointed, each of whom chooses four to six members of the class as a group. This number is flexible and depends on the size of the class. A group of more than six is unwieldy, one of less than four is rather uninspiring.

The topics are not arbitrarily assigned, but are chosen by the groups. If we have more groups than topics we subdivide. Wildlife, for instance, can be divided into problems of fishes, furbearers, game, birds, and wildflowers. Each group then collects its own material, prepares a written group report, and gives an oral original presentation before the entire class.

Extra credit is given for originality of presentation. We have had effective programs which have been both entertaining and instructive. The material has been presented in various forms, such as: (1) plays, (2) mock radio presentations, (3) round table and/or panel discussions, (4) debates, (5) trials. We have used the outstanding of these for our school assembly program during Community Conservation Week.

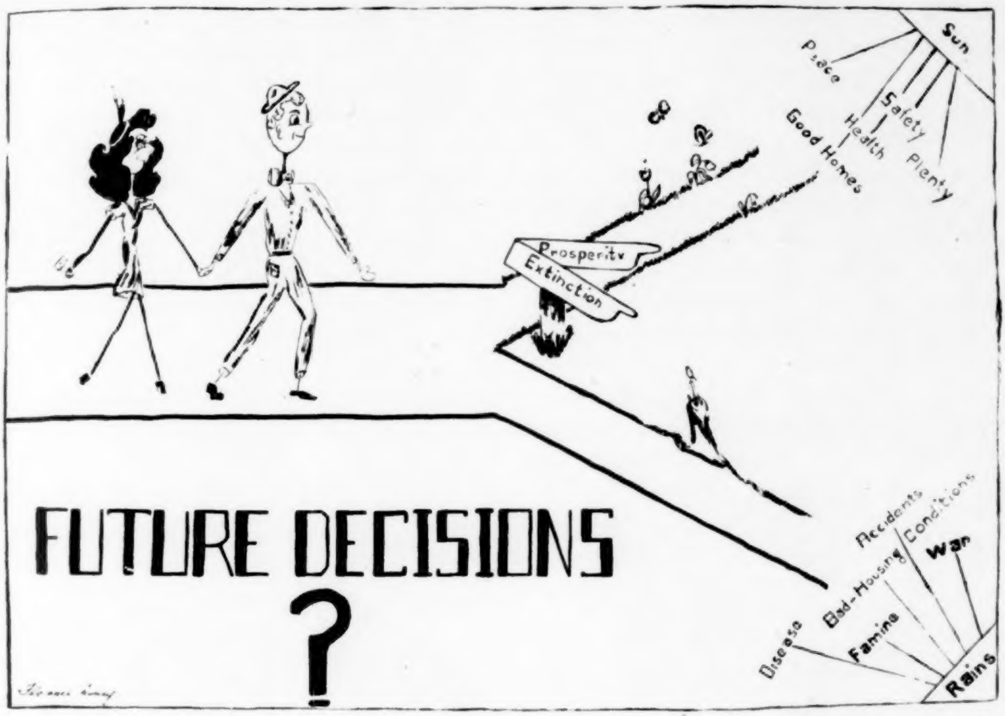
Models, drawings, maps, graphs, posters, etc., are worked out by the groups and used as illustrative material. Samples of soils and forest trees, cones, seeds, and products are always used as interesting demonstration.

About two weeks of class time is devoted to the gathering and organization of the information. A variety of books and encyclopedias, collected pamphlet material from various government agencies and industry, newspapers, natural history magazines and radio reports are the primary reading sources. Extra credit is offered and emphasis is placed on student responsibility for gathering first-hand information. They make direct personal contacts with local soil conservation offices, farm advisors, foresters, doctors, and game wardens. For example, they write letters to museums, universities, and wildlife agencies for factual information and have voluntarily contributed money to such organizations as "Save-The-Redwood-League." For the class presentation a general survey of the topic is given and then local problems discussed and emphasized. Some of the important local problems under discussion have been:

(1) The problem of the 20,000 acres of dredger piles of waste land in our community;
(2) Support for the State Legislature's bill to compel dredger operators to replace top-soil;
(3) The white pine blister rust problem and its control in the Plumas National Forest, our nearby forest;
(4) Forest fire menace—many of our boys serve in fire control camps each summer;
(5) Lumber industry problems;
(6) Reforestation in nearby areas;
(7) Central Valley Project—Shasta Dam —said to be the largest conservation project in history of man;
(8) Local farm and grazing land problems;
(9) Personal health habits;
(10) Safety; local and national safety problem. Accidents, causes and control of important diseases, world food problems. Health insurance problems.

The gathering of material on these problems has always involved discussion in the home as well as in school. This stimulated home discussion has contributed measurably to our school's community public relations program.

At the end of the unit a practical test is given to determine the ability of the student to apply the principles of crop rotation, cover crops, terracing, construction of check dams, utilization of



Poster prepared by group in summary of "Conservation of Human Resources" (1944)

water supply, game refuges, value of forest areas, etc. One part of the test is given over to the planning of the wise use of a hypothetical 320 acres covering a 10-year period. Ample time is allowed for careful planning and no two plans necessarily are alike. In other words, the student applies *principles* and does not strive for "the answer." The other part of the test is given in the form of a voter's ballot. On this ballot are listed various referendum-like propositions, similar in form to those presented in a state's election. The students are asked to indicate how they would vote on these measures and to list their *reasons* for so voting. Grades are assigned on the basis of reasons offered rather than on the choice of indicating "for-or-against" these measures.

This form of a test has provided the students with a consciousness of the practical application of the principles of conservation measures facing them as citizens of a community. It is a type of test which the students actually take with pleasure as well as providing them with the opportunity for rechecking their own information.

In this unit we provide an opportunity for the student to share his knowledge and experience with the other members of the class. We eliminate all formal teaching and feelings of dependence on the teacher as a source of information. Here we have the opportunity of presenting conservation as a unified subject in which *interdependence* of soil, forest, water, and wildlife is stressed. The student soon finds he cannot talk about "soil problems," as an isolated topic. He must deal with water and wildlife as well. Thus the recognition by the student of interrelationships becomes a dominant part of this unit.

The students recognize the value of conservation practices far more readily if first we have built a firm foundation

of interdependence of plants and animals and the interrelations of the organic and inorganic worlds. We find thorough familiarity with the principle of "Balance of Nature" smooths the path toward wildlife conservation. A colleague[3] in a nearby community expressed succinctly at a recent Butte County Teachers Institute "in Biology we teach balance of nature and conservation everyday throughout the year."

IRVING KEENE, Brookline High School, Brookline, Massachusetts, president of the *New England Biology Association*, has taken a most active part in the arrangements for the Boston meeting, the group which he heads being the host association. Other members of the New England group are: Mary Lyons, publicity; Eva Amidon, reception; former president Malcolm Campbell, banquet; Warren Bartlett, registration and Irving Keene, exhibits and tours.

The Urgency of Conservation Education*

FAIRFIELD OSBORN
President New York Zoological Society

There are two major threats in the world today, either one of which would cause incalculable loss of human life, if not the breakdown of the entire structure of our civilization. The first is the misuse of atomic energy. Everybody everywhere knows about that now so presumably steps will be taken to ward off that perilous danger. The other is the continuing destruction of the natural living resources of this earth. This conference is being held in order to help ward off this second incredible threat to everything that is alive on the earth. Human beings, wildlife, forests, soils, water sources, are all in the same basket. Let's not fool ourselves. The Good Earth may be able to get along without man—as a matter of fact, it did successfully for many long ages, and could again today. But man cannot get along without the Good Earth, and when I say *Good Earth*, I mean all the natural living things on this earth, the things that conservationists refer to as renewable resources—forests, animal life, soils and waters. Every conservationist knows that these are one and all inter-related and inter-dependent. But the public does not know this fact; the industrial corporations don't know this fact; the legislators don't know this fact—except for a few of them. The truth is our government and other governments give no evidence that they actually realize what is going on, or, let us say, realize the extremity of the seriousness of the situation both here and in other countries.

The third of the Four Freedoms, "Freedom from Want," Dumbarton Oaks, the San Francisco Conference, the U.N.O. meetings—all of these reachings of the human mind and spirit for a better world can well prove futile efforts unless the conservation of renewable resources becomes a cornerstone of cooperative effort, of governments and people alike. Time is running out—increasing human populations on the one hand, decreasing life resources on the other. How much longer have we got to go? Not very long.

[3] Mrs. Edith Strong, Biology Department Biggs Union High School, Biggs, California.

* Address before the Annual Convention of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS in conjunction with THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, St. Louis, Mo., March 30, 1946.

Strong efforts are being made in this country—through certain departments of the federal government as well as by numerous state and private agencies, but truly they are not enough. All of you here today in your heart know that they are not enough. One widespread cure not only for this nation but through its influence upon other nations, is to be found from education in all channels of our life. Perhaps it is the only cure. In any event, we all know it is one of the major cures.

The essence of man's situation is slowly becoming obvious. His physical adaptability, in the pattern of biological history, provided, until recently, its own guarantee of his survival. The characterizing of man as a generalized type, and therefore as one most capable of adaptation to changing conditions, seems illogical now—outdated by the course of events of even the last few decades. Today one cannot think of man as detached from the environment that he himself has created. True, one never actually was justified in doing so. Yet even as recently as the latter years of the last century, the projections of man's mind in the form of the physical changes he was effecting on the earth itself, were not of sufficient extent to be recognized as a new and profound change in the evolution and even in the destiny of mankind. The groundwork had been laid in earlier centuries. The explosion, world-shaking, has occurred in this one. The mechanical, chemical and electrical sciences, man's mind-extensions, are changing the earth. A concept, recently expressed, speaks of man as now becoming for the first time a *large-scale geological force.* The effects upon man's social and political relationships are not within the immediate scope of my remarks today. It is clear, however, that the present world-wide disturbances in human civilization are the result in large part of the havoc that man is working upon his natural environment. These disturbances will unquestionably increase in violence, even to the point of social disintegration, if the present velocity of destruction of the earth's living resources continues. Man has it in his power to stop this havoc. He also still has it in his power to remedy enough of the damage that he has caused to permit the survival of his civilization. The question is will he do it and will he do it in time.

Man, then, has exchanged the safety and flexibility of generalized characteristics, which since his primitive days have assured his survival, for extreme specialization. Through the development of the physical sciences, funnelled into vast industrial systems, he has created and continues to create new environments, new conditions. These extensions of his mind-fertility and mind-restlessness are superimposed, like crusts, on the face of the earth, choking his life sources. The conditions under which he must live are constantly changing, he himself being the cause of the changes. He has almost lost sight of the fact that the living resources of his life are derived from his Earth-home and not from his mind-power. With one hand he harnesses great waters, with the other he dries up the water sources. He must change with changing conditions or perish. He *conquers* a continent and within a century lays much of it into barren waste. He must move to find a new and unspoiled land. He must, he must—but where? His numbers are increasing, starvation taunts him—even after his wars too many are left alive. He causes the life-giving soils for his crops to wash into the oceans. He falls back on palliatives and calls upon a host of chemists to invent substitutes for the organized processes of nature. Can they do this? Can his chemists dismiss Nature and take

over the operation of the earth? He hopes so. Hope turns to conviction—they *must*, or else he perishes. Is he not Nature's "crowning glory"? Can he not turn away from his creator? Who has a better right? He has seemingly "discovered" the secrets of the universe. What need, then, to live by its principles!

The peoples of the earth, whether they will it so or not, are bound together today by common interests and needs, the most basic of which are, of course, food supply and other primary living requirements. These come, all of them, from nature and from nature alone—from the forests, the soils and the waterways. Man's problem in his earliest, dimmest, most far away days was obtaining a living from these elements. The wheel of human destiny seems to turn, but the basic facts of life remain constant. Man's initial problem is still with him—can he obtain a living from nature? The population of the earth has increased four times within the last three centuries and doubled even within the last century. Human civilization has permeated every living area of the earth's surface. Vast fertile areas in various parts of the earth have been injured by man, many of them so ruined that they have become deserts and uninhabitable. In such places flourishing civilizations have disappeared, their cities buried under wastes of sand, their inhabitants scattering to new lands. But *now*, with isolated and inconsequential exceptions, there are no fresh lands, anywhere. Never before in man's history has this been the case.

With all of the above being true, how can any teacher, and, above all, any teacher of biology stand aside? If you do stand aside, if you fail to cope with this situation that goes to the very essence of the lives of every student, that affects the future well-being of every student in every school and in every college in our country, I believe in the years to come you will look back upon your failure to act with a regret the depths of which are not easily to be measured. Granted you have a difficult and complicated course to follow to achieve the full objectives that are so greatly needed. But is it not now clear that the teaching of Conservation of natural living resources should become not only an integral part of biological teaching but beyond that should be integrated in the general curricula of our schools and colleges? As to Biology, it can be either an objective study not related to our own lives or it can be to an ever-increasing degree a close matter of personal interest to every student. In simple terms the new science of Conservation involves the acquiring of knowledge concerning the intimacy of human beings and their natural living environment. The teaching of Conservation would vitalize and give a greater purpose to the teaching of biology. An understanding of the fact, for instance, that productive soil is *alive* would be a revelation to most students. A knowledge of the interdependence and inter-relationship of all animal life, from mammalian forms to the micro-organisms which help to make productive soils, of the relationships of forests and water sources to our own physical well-being—all of these ecological facts that are now beginning to be comprehended—would illuminate in the students' minds the underlying truth that nature and man are all of one essence and that man to survive must learn to cooperate with nature. A comprehension of the principles of Conservation would give added meaning to practically every subject of which one can think in the general curricula of our schools and colleges—history, chemistry, engineering and even philosophy. No group of teachers are in as good a position to forward this movement as are biology teach-

ers. The truth is the job does actually fall upon your shoulders. In a sense, I pity you because of the difficulties you must undergo in accomplishing the purpose in view, as I have at least some idea of the problems involved in changing established forms and methods of teaching. You will almost need to develop two personalities—one, your "regular" self, the other the form and spirit of an evangelist—for if you believe the things that I have attempted to express to you today you will no longer be able to rest quietly until you have done your part in bringing about widespread education on this most vital subject.

The Topic of Greatest Importance in Biology Was—

CHARLES E. PACKARD
Alfred University, Alfred, New York

The development of judgment and critical appraisal should begin as early in the training of the child as possible. Often, no doubt, it starts in the first years of school without our being aware of its inception and progress. Do we consciously foster it enough? Do we deliberately set about to see that it is given the opportunity to grow? There are many chances, offered in a great variety of ways, for the alert teacher to bring out analytical powers in the schoolroom, to stimulate correct thinking habits, and to provide an outlet for the growing child mind.

In order that pupils might be led to give consideration to the value of biology to them as individuals and to society as a whole, two classes, consisting mainly of sophomores at the high school level, were asked to submit the topic which seemed to be of *greatest importance* among those they had considered during the first half of the year. A few upperclassmen also participated in the exercise. A twenty-four-hour interval was allowed for thinking the matter over. Forty-two girls and twenty-five boys returned answers, given with varying degrees of care and discernment.

This exercise was prepared in conjunction with another which concerned pupil interest in topics considered during the fall and early winter months. Results and discussion of the study were incorporated in another paper.[1] Very likely it would be simpler for the pupil to state what special part of his work had been most interesting rather than to evaluate it. No complaint was heard about either request and both were fulfilled with some enthusiasm. A few returned more than one answer, indicating difficulty in choosing between portions of the subject matter. In many of the discussion periods the direct and indirect worth of what was being taken up at the time was brought out. Opinions were never dictated but direction through explanation was frequently offered and inserted when experience on the part of the pupil could not supply the same. Therefore, the author does not feel that he formulated the opinions of the group. Enough leeway was given through the many and varied items covered so that a certain amount of discrimination and critical thinking had to be exercised.

There was some parallelism between the set of replies and those made in response to the question about the most appealing and interesting facts. Also

[1] *The American Biology Teacher*, November, 1946, pp. 51.

the same answer in about the same words and phrasing appeared more than once yet not often enough to indicate a marked degree of collaboration. Reasons for selections made were not called for although it was hoped that some would be voluntarily given. That desire of the instructor's was fulfilled.

The texts[2] used were standard and well-known. Naturally the order of treatment of subject matter in each was a little different. For the most part one class consisted of college preparatory electees whereas those in the other had chosen the "general" course. In each there was a sprinkling of home economics and commercial majors. A critical teacher shortage prevented the agriculture work from being given for the year which carried a larger number of boys away from their regular schedule into the biology not ordinarily offered them. For purposes of lightening the teaching load and running laboratory work more efficiently, the hours for biology ran consecutively and there was no interval provided for changing materials. Therefore, the courses were much alike as to content. Yet an effort was made, in spite of all the hurdles to overcome, to stress theoretical matters more fully with the classical pupils and to bring out rather forcefully the pragmatic for those taking the work without the idea of going on to college or taking up medicine, nursing, etc., as a profession.

In either case introductory presentation would lean a bit more towards the basic and abstract than to the directly beneficial. Work with the cell, the tissues, the organ-systems, protoplasm and its nature, classification, the plant and its place in nature, and the major groups of lower animals formed the bulk of what was taught for the half-year concerned. Health and sanitation, bacteria and their relation to disease, bird study, wild-life conservation and care, economics of natural resources, breeding and animal and plant improvement had not been mentioned except incidentally from time to time. It can be seen that possibly the most vital portions of biological fact had yet to be presented. Because of this the assignment required somewhat more thinking than the second half of the work would have. It would have been interesting and valuable to have repeated the question at the year's close but such was not possible. It is felt that worthwhile results for guidance are to be found in the tabulations made from available data, however.

[2] *Everyday Biology*, Curtis, Caldwell, Sherman; Ginn and Co., Boston. *Biology*, Moon and Mann; Henry Holt Co., New York.

TABLE I. *Relative Importance of Topics*

	Boys	Girls
Directly beneficial	7	6
Indirectly beneficial	17	33
Unclassified	1	3

TABLE II. *Most Important Fact Learned*

	Boys	Girls
That Biology is the study of plants and animals	2	10
The topic, and the study, of plants	0	2
The study of animals	1	0
The study about animals ranging from simplest to highest	1	0
The gradual development of animals until the most perfectly developed stage is reached, which is man	1	0
Comparing each animal with others lower in the class	1	0
The organs of animals	0	1

"The facts we studied concerning parts of animals"	0	1
Plants and living matter	0	1
The striking and fundamental likenesses between plants and animals	0	1
The relationship between plants, animals and man	0	2
The study of the living and things that have been living	1	0
All living things have the same foundation material, protoplasm	0	1
All substance in the world is either organic or inorganic	2	2
The common functions of nutrition, sensitivity, and reproduction	1	2
Definitions of the various kinds of sciences such as biology, geology, zoology, botany, bacteriology, physiology and many others	0	1
Embryology	0	1
"The development of life starting with the plant cell and continuing through to the most complicated living thing, the brain"	1	0
Insects, insects and man, insects and plants	2	4
Metamorphosis	2	1
Insects and crop damage; control	0	3
"Characteristics and adaptations of all animals and plants, their struggle to live, especially insects"	0	1
Pollination and fertilization of flowers	1	1
Economic importance of animals	1	0
Protozoa	1	0
"That the hookworm enters through the foot"	1	0
That some invertebrate animals, roundworms and flatworms, get inside the human and live there as parasites	1	0
That there is only one poisonous lizard and only four poisonous snakes in the U.S.A.	1	0
Amphibia and reptiles	0	1
Fish	1	1
Spores in blister rust	1	0
Photosynthesis, its results	2	2

"That fossils can be traced back to animals living thousands of years ago" was listed by one girl. Her class marks were low but her mind was active and it would have been interesting to find out what she would have given as her reason for selecting that fact. One boy wrote "I have *enjoyed* the study of prehistoric animals the best so far in Biology," probably mixing the assignments of interest and importance. A number handed in several answers. One girl wrote her name but her paper was blank. She came from a family of slender means, worked a great many hours after school, was often seemingly embarrassed by lack of preparation, did conscientious work for the most part and possibly thought that she would have to account for herself if only by handing in a slip. Of course she may also have found herself in a dilemma over choosing between several items considered important and refrained from committing herself to a single one. As can be seen, practically the entire class engaged upon the performance in spite of its rather forbidding nature, and produced a variety of answers. A few of these are quoted as follows:

"If it was not for the process of photosynthesis (the action of chlorophyll and light in producing carbohydrates in green plants) there would not be any form of life on earth." (Boy)

"Pollination and fertilization of flowers is the most important subject we have studied because after we learn how this is done we can raise better plants as we will have a better idea of what we can do to help them grow." (Girl)

"The most important fact is that Biology is the study of plants and animals in order to know what you are going to find out about." (Unsigned)

"It is all very important because without knowing about the fundamental things, we wouldn't be prepared for further studying." (Girl)

"The most useful fact was how plants pollenize and keep on living." (Boy)

Most important is insects and plants, "They have so much to do with man and all other animals." (Girl)

"Facts concerning some of the methods used in intensive insect control, such as spraying, or importing insect pest's enemies." (Girl)

"I have learned several things of importance in my course of Biology. Before studying the divisions of labor, characteristics, etc., of plants, and animals, nature meant very little to me." (Senior girl)

There was definite correlation between experience and the type of choice made, in some instances. Two sisters living on a farm realized, and spoke of, the task of fighting insects pests. A boy had had summer work on eradication of carriers of pine blister rust. A youth living on a poultry farm understood the economic significance of parasitism. Several were undoubtedly influenced by the discussion of the value of the fisheries industry and comments on salmon, formerly very abundant in the Connecticut River. The legend is that farmers used to drive to the river and load their carts with this now valuable fish, hauling them away in some cases for fertilizer, and it is very natural that the vital connection between food manufacture in the chlorophyll-bearing plants and the sustaining of all life should make its appeal. In view of the stress placed upon some of the more outstanding phenomena of living things it seems unusual that they received such scant attention. There may have been some collaboration but the replies are too varied to admit of much copying. They show considerable independence of thinking as a matter of fact. In this study they frequently revert to early lessons, possibly because of frequent repetition of basic fundamentals. For instance, on appropriate occasions pupils were directed to recall relationships existing between all forms of living matter such as need for food to keep the individual functioning, response to stimuli to help in its survival, and the ability to reproduce to ensure propagation of the race.

From the study, brief as it may be, one may learn to be cautious about saying that boys and girls of this particular age are not too well able to express competent judgment concerning relative values. They have opinions and can support them. They can be taught to reason and to think critically.

Members of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS are cordially invited to attend two sessions at the Boston meeting sponsored by *The Cooperative Committee on Science Teaching* of the AAAS.

Friday, Dec. 27, 10:00 a.m.

Parlor A, Bradford Hotel

Dr. Oliver J. Lee presiding—Three papers, as follows:

"Science Counseling in Secondary Schools," R. W. Lefler

"Certification of Science Teachers," K. Lark-Horovitz

"The Crisis in Science Teaching," Raleigh Schorling

Sunday, Dec. 29, 8:00 p.m.

Oval Room, Hotel Bradford

Forum on *Problems of Science Teaching*

Anton J. Carlson will be moderator and K. Lark-Horovitz, Morris Meister Laurence L. Quill, and Raleigh Schorling will participate.

Annual Convention
of the
NATIONAL ASSOCIATION OF BIOLOGY TEACHERS
in conjunction with
The American Association for the Advancement of Science
meeting at Boston, Massachusetts, December 27 and 28

Headquarters at Hotel Bradford

PROGRAM

FRIDAY, DECEMBER 27

9:30 A. M. and 1:30 P. M.

Business Meetings of the Representative Assembly, Executive Board, Editorial Board, Membership and Other Committees

SATURDAY, DECEMBER 28

Symposium on Ecology and the Teaching of Ecology

Theme: What is Ecology and how may it best be taught?

Morning Program: (Lobby Ball Room)

What in Ecology is Most Significant to the Biology Teacher?

9:00 A. M. *The Ecologists' Viewpoint*, J. M. AIKMAN, President, Ecological Society

9:30—*The Botanists' Viewpoint*, NEIL STEVENS, President, Botanical Society

10:00—*The Limnologists' Viewpoint*, J. G. NEEDHAM, Cornell University

10:30—*The Malacologists' Viewpoint*, HENRY VANDER SCHALIE, University of Michigan

11:00—*The Zoologists' Viewpoint*, LOWELL E. NOLAND, University of Wisconsin

11:30—*The Paleontologists' Viewpoint*, HERVEY W. SHIMER, Massachusetts Institute of Technology

Afternoon Program: (Parlor B)

The Teaching of Ecology

2:00 P. M. *From the Nature Study Viewpoint*, RICHARD WEAVER, Audubon Nature Center

2:30—*From the General Science Viewpoint*, CHARLOTTE GRANT, Sarah Lawrence College, New York, representing National Science Teachers Association

3:00—*From the General Education Viewpoint*, FRANCIS CURTIS, University of Michigan, representing Department **Q**, AAAS

3:30—*From the Biology Teachers' Viewpoint*, HOWARD MICHAUD, President-elect of The National Association of Biology Teachers

6:30 P. M. Annual Banquet, **Copley Plaza**; address by PAUL B. SEARS, Oberlin College, Human Ecology.

Reservations may be made at our headquarters in the Hotel Bradford

Guests and friends are cordially invited

President, PREVO L. WHITAKER

Program Chairman, E. LAURENCE PALMER

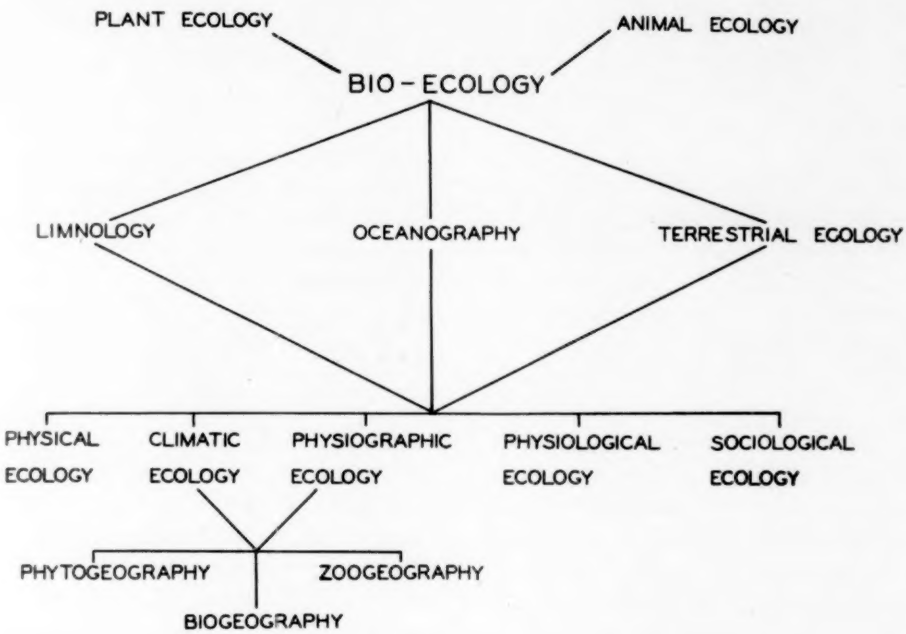
Facets of Ecology

RALPH W. DEXTER
Kent State University, Kent, Ohio

Ecology has been defined as the science of communities (Shelford 1930). Some biologists believe it is more a point of view than it is a separate science. In either case, the study of ecology is a broad over-view of the interrelationships of living things with each other and with their external surroundings. The writer has shown in the pages of this journal (Dexter 1945) how the science of ecology forms the very hub of the pure and applied natural sciences. Being so comprehensive in character, embracing the cause and effect relations of natural processes of the living world, it is a hub of many facets.

The modern science ecology first developed as plant ecology under the direction of botanists who became interested in the study of plants living in their natural habitats (Warming 1909). Zoologists soon followed the lead and founded the modern study of animal ecology (Adams 1913), first adopting the general methods of the plant ecologists and later introducing techniques for the specialized study of animal populations. The two main pillars of ecology have remained as separate compartments of study (Weaver and Clements 1938, Pearse 1939) to the present day for the reason that most students of the life sciences are either botanists or zoologists with specialized interests. In recent years an attempt has been made to synthesize the plant and animal aspects of ecology into a unified science of *bio-ecology* (Clements and Shelford 1939). The name bio-ecology might seem redundant, but it serves the purpose of emphasizing the unified character of the science. Biologists in general have not yet developed the concept of ecology as a unit, but rather think of it in terms of the sister sciences of plant and animal ecology. Of course, there is still a place and a need for the development of each as a separate field in the prosecution of specialized research, although it is most desirable to further research and study along lines which integrate the relations of plants and animals living in a common group.

The study of external relationships of a single species or a restricted taxonomic group is *autecology*. This may take the form of such studies as the ecological relations of the burroweed (Humphrey 1937), of the field mouse (Hamilton 1937), as insect ecology (Balduf 1935), or bird ecology (Twomey 1945). In some cases, a portion of an organism may be studied with respect to its environment, in such a specialized science as root ecology (Nedrow 1937). When the whole mass of vegetation or the entire animal population form the basis of the problem, the science is labelled *synecology*. Examples here may be drawn from such works as the survey of animal communities of a particular region (Shelford 1937) or the vegetation of a certain locality (Braun 1942). In its broadest sense, synecology becomes synonomous with bio-ecology (also called general ecology and bionomics). A community study may be made on a large scale, covering an extensive area with a diversity of ecological situations (Davis 1943), or it may involve the inhabitants of micro-habitats, such as treeholes (Lackey 1940). In the final analysis, a com-



plete understanding of ecological phenomena and principles depends upon the viewpoint of bio-ecology inasmuch as all organisms, plants and animals, live in communities (Phillips 1931).

Bio-ecology can be divided into three domains according to the sphere in which the communities exist.

1. The study of fresh water ecology is known as *limnology* (Welch 1935). Many specialities have developed in this field—lake ecology (Hutchinson 1941), river ecology (Butcher 1933), fish ecology (Pearse 1934), *etc.*

2. The study of marine communities and their salt water environments is called *marine ecology*, a phase of *oceanography* (Bigelow 1931; Sverdrup, Johnson and Fleming 1942). Intertidal ecology (Colman 1940), salt marsh ecology (Chapman 1938), subtidal ecology (Kitching 1941) are some of its branches. The latter two provinces (limnology and oceanography) are sometimes spoken of collectively as hydrobiology or aquatic ecology.

3. Land organisms are studied in the name of *terrestrial ecology*. Here again many subdivisions occur. The research may be concerned with a particular type of community such as forest (Williams 1936), grassland (Weaver and Fitzpatrick 1934), or desert (Shreve 1934) ecology. Special situations appear as mountain (Darlington 1943), cave (Ives 1927), or soil ecology (Jacot 1936).

The process of *succession* (i.e., the development of a climax community) has been studied intensively (Clements 1928). Successional communities are dealt with in the name of bog and swamp (Aldrich 1943) or marsh (Penfound and Hathaway 1938) ecology. In some cases a regional point of view may obtain (Dice 1943), such as arctic (Cooper 1942), or tropical (Beard 1944) ecology. Community activities and the behavior of animals at night receive the special title of nocturnal ecology (O. Park 1938). With man as the central theme, we have a new and unexplored field—human ecology (Bews 1935). This phase, however, is practically the same as certain aspects of anthropology on one

hand and of modern geography on the other. Many hold to the opinion that as such the investigation of human ecology should be left in the hands of the social scientists.

Any of the three domains of ecology may be approached from the field of botany or zoology; or an entire community may be viewed from the combined discipline, bio-ecology. Studies of any type of community or interrelationship may be based upon a few selected factors. Thus, the study of the effects of temperature or moisture or of a combination of such factors on organisms or a group of organisms is designated as physical ecology (Sweetman 1938). If the physical factors of the atmosphere are considered together in their influence on plants and animals in determining local and geographical distribution, we are dealing with climatic ecology (Hopkins 1938). Climatic conditions of the geological past as indicated by fossil remains is the new but rapidly developing field of *paleo-ecology* (Cain 1939). Hydroclimatic ecology is concerned with the "climate" or sum total of physical characteristics of aquatic environments and their bearing on water life.

The topographic features of the earth and the physiographic processes in operation thereon bear certain relationships to the distribution of plants and animals as species and as biotic communities. The organisms in turn react upon their physical surroundings. These aspects fall in the category of *physiographic ecology* (Braun 1916). Climatic and physiographic ecology unite in the provinces of *phytogeography* (Cain 1944), *zoogeography* (Hesse, Allee, and Schmidt 1937), and their combination in the new synthesis of *biogeography* (Newbigin 1936) which is the study of the geographical distribution of biotic communities.

Organisms make precise requirements of their environments and are able to adjust themselves within limits to the existing conditions. Temperature, moisture, light intensity, acidity, *etc.*, affect the metabolism and behavior of plants and animals. This adjustment of internal functions to the external conditions is the concern of physiological ecology (Odum 1941). A recent development and extension of this field is known as biogeochemistry (Hutchinson 1943).

Relationships between living things are defined as *coactions*. This phase of ecological science is sociological ecology. Here are studied community organization (Clements 1936), food chains and food cycles (trophic ecology—Lindeman 1942), aggregations and mass physiology (Allee 1931), parasitism (Clausen 1936), disease transmission (Leach 1940), symbiosis (Cleveland 1926), and peck dominance and peck right (Bennett 1939). Comparative ecology aims to show similarities of structures and processes in related communities and their environments (Brown 1931). Experimental ecology brings the field problems into the laboratory for detailed analysis under controlled conditions (T. Park 1937), or devises simple field experiments for testing cause and effect relationship under natural conditions (Hiesey 1940). Conservation is in essence applied ecology (Hanson 1939). This phase was discussed in the writer's earlier article.

Any field study demands precise sampling. Some studies are concerned chiefly with sampling techniques and their interpretation (quantitative ecology—Ashby 1936). *The Ecological Society of America* has a special committee which is studying quantitative ecology. One aspect of this of economic importance is the study of the dynamics of animal populations (Errington 1945).

Often an investigation may be a com-

bination of any two or more of the facets mentioned here. There are no sharp boundaries between related angles; there is, in fact, overlapping throughout. A question in one field may find its answer in another. Thus, climatic differences associated with a change of physiographic type may explain the phytogeographic pattern of a region, and through experimental analysis a given physical factor may be singled out to be the controlling one according to Leibig's law of the minimum. Or again, the decline of a population may depend upon an increase of its enemies through successful reproduction brought about by favorable environmental circumstances during the breeding season coupled with increased fecundity. Ecologists include representatives from nearly every other branch of biology. Every biologist interested in an organism as an entity is an ecologist of a kind. Most ecologists have a special interest in some other field of biology such as entomology, ornithology, or algology. Sometimes a study defies classification in any recognized branch of ecology; sometimes a new facet is added to this new, expanding field of ecology.

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Biology and Conservation Education

A Contribution to the Conservation Program from the Administrator's Viewpoint*

I. T. BODE

Although I have dabbled in the teaching of college classes, Sunday School classes, Boy Scout troops, 4-H club groups and others, I do not assume to come before this group as an educator or even a trained teacher. I speak merely as a present administrator of conservation affairs, and as one who has spent a good many years trying to get done the practical job of conservation of some of our natural resources. A great deal of that effort has been in connection with the forest and wildlife resources. Regardless of some of the common conceptions of those fields, especially wildlife, we are coming to know that conservation of these resources is identical with conservation of all other resources. It is only fair to state that my viewpoint here centers around the management phase of wild forms.

* Address before The National Association of Biology Teachers, of the American Association for the Advancement of Science, Saint Louis, Missouri, March 30, 1946.

I expect to talk frankly; I believe you want it that way. I do not expect all of you or even all of my contemporaries in my field to agree with me. I make these remarks with a sincere recognition of the many steps forward that have been taken recently in the matter of teaching of biology to youth, and of the growing interest in it.

I suppose we should examine the need for such teaching, for there should be some real human need or desire fulfilled by all of our teaching of youth. My personal conviction is that in the field of wildlife conservation there is no more important function, if indeed there is any function as important, as education. But, while it is the most important of all our functions, it gets the very least attention.

There is no field in which thinking, from among administrators on, from youth to grandfather, is so jumbled, diversified, narrowly independent, and unscientifically guided as in the field of "applied biology" or management of wildlife resources. And yet, human-relationship consideration of this field deals with a resource effecting a business turnover annually of more than $2,000,000,000. Over 30,000,000 people we know are interested, because that many pay a license or permit fee to hunt and fish, and those that are permitted to hunt and fish without procuring a permit are probably as many. This does not take into consideration the millions who utilize wildlife resources for purely aesthetic purposes and enjoyment, and it does not consider the indirect, economic values which are myriad but upon which it is difficult to place tangible values. There is, then, a large percentage of the human population directly interested in this resource, and let me tell you, that with no wildlife resources, there will be no civilization left. Because of its abundance until now, we have taken it for granted and have supposed it will always be a present resource.

Biological teaching has fallen short of the mark. I do not mean to imply that there has been a lack of teaching of biology. The subject has been in our curricula for many years. But, most of it has been in the abstract. It has not been tied in with human experience and need as have most of our other subjects.

For the purpose of this discussion I am dividing biological teaching or thinking into two phases: the **nature-study-school** type and the **utilitarian** or use type. With the first, we have done a fairly thorough job of incorporation into the teaching field. With the second, there is little thoroughness or science in our thinking. It gets into the field of game management and fish and game administration and regulation, and so far, has been dealt with largely by the layman. I doubt if there is any field in which thinking is so narrowly individualistic, so self-interested, so based on casual observation and unskilled analysis of daily-occurring phenomena. If a man were to run a farm on the same basis as is attempted in most cases for wildlife administration and management, he would be broke in six months.

Why is this so? Because in this field until rather recently knowledge has been obtained in the old antiquated fashion of word of mouth, legendary belief, and distorted analysis of experience. People have taken for granted that wild creatures are divinities that can by Godlike power overcome any change in habitat and any abuse. People have taken for granted that all wild forms are the sole and indisputable individual property of everyone and anyone who may wish to take them at any time and in any quantity. People have accepted as gospel the antiquated preachments of handling game and other wildlife.

Nor can we lay too much blame on the

shoulders of the people generally. We have provided very little upon which growing generations can formulate conceptions of what constitutes wise handling of these resources. We have included in our teaching much on agriculture, soil, citizenship, industry, sociology, and other subjects, but it has been a herculean task to get educational programs to recognize anything beyond butterflies, wildflowers, dickybirds, and a type of nature study that loses all staying power by the time the individual has reached his teen age. As in most of our extracurricular youth programs, we have then set the young human being adrift without any transition anchors, and at a time when his own thinking is apt to be turning from the aesthetic side to that of hunting, fishing and the materialistic interest in these resources. We have left him dangling in the air, grasping for things he wants, at a time when he is becoming most vigorous in his utilitarian proclivities. Why is the teaching of hunting and fishing, the use of a gun or fishing rod, the purpose of game laws and regulations, and especially the relationship of wildlife production to human sociology and to the land a thing to be frowned upon? I have had teachers tell me that they are perfectly willing to teach the raising of animals, their life history and aesthetic values, but to implant in the mind of the child the idea of "killing" by talking hunting and fishing and game management is sacrilege for the child. Which does him the greatest wrong: the teaching of how these things can and should be done, what it takes by way of regulation, land use, care and mutual effort to perpetuate the resource, what the dangers to human life are when the use of a gun is careless, or the filling him full of the beauties of nature, the wonder of the life of the bee, and a lot of other things which have no appeal to him by the time he has the urge to pursue, and the leaving of him to get his training concerning the utilitarian activities from unreliable sources? One thing is as sure as the fact that youth grows into manhood, he is going to go hunting and fishing; he is going to manifest interest in and have something to say about how these things are administered, and what kind of effort will be made with the money he puts out for his use permits. There seems to be no hesitation about teaching youth the fundamentals of good cropping of agricultural lands, livestock, etc. There should be no more hesitation in teaching the fundamentals of production and harvesting of wildlife crops. The youth has learned his conservation on the dream side and in the abstract during his impressionable age, when his education is supposed to be built scientifically and psychologically correct. His education on the use side of biology and wildlife harvest is being obtained from sources just as powerful psychologically, but certainly based on anything except sound science, factually or pedagogically. His youth biology has been an unrelated thing. His everyday life relationships to soil are not connected with his daily experiences and inherent desires. The result is that the aesthetics he learned as a youth become submerged under the desires for use which he attains to at about the age of 16 or 17, and for the answers to those problems and urges he must turn to sources very much outmoded and very unscientific.

A pointed example of this is the following report from what is supposed to be one of our most advanced states in fish and game work:

"The ———— Conservation Department last month announced detailed plans for a postwar program, the labor and construction alone of which would total $20,000,000. . . . Fish and game projects due to start soon, it was explained, include the ———— game farm, the giant new ———— hatchery on ———— lake, one of the nation's larger trout hatcheries . . . the construction of new

game-propagation facilities on six game farms, building of more ponds and structures on 20 fish hatcheries. . . ."

All this, and yet the best scientific knowledge we have dictates that no such program of itself, although carried for 30 years or longer, has produced any more wildlife, except as it has incorporated the fundamentals of soil and environmental improvement on the land itself. One wonders what the ultimate result might be if a generation of youth were turned out, who will some day be in charge of such huge expenditures and who have learned in their biology courses the scientific facts about wildlife production. Neither the problem nor the fault lies with the youth, and perhaps not with the teacher. Why has it been so? Because there has been no one to teach and there have been very few taught how to teach these things to the boys and the girls. There are few places where teachers can get or are encouraged much to get proper orientation in this field.

I do not confine myself to the school, either. How many Boy Scout and Girl Scout and Camp Fire Girl and other like programs teach anything beyond bird and animal identification? The boys and girls are taken out to the woods to be taught wood-shop working, handicraft, sewing art and many other subjects. But how much time is devoted to studies of the soil and its human relationships, wildlife as it lives, methods of wildlife management, what constitutes game cover, how a hunter or fisherman should conduct himself, and other subjects governing his future conduct in this field, at the time when he is in the environment of these things?

I wonder sometimes if we should not eliminate the word "biology" from our grade schools and youth curricula altogether, and substitute such things as "man and animals," "animals and the land," "raising and using wildlife crops."

The foregoing is one side of an administrator's viewpoint. Here is another which is directed at the administrator himself.

There is no administrator today who does not face the problem of supplying an ever growing demand under intensified use pressure. There is probably no administrator who does not recognize how greatly his "headaches" would be relieved if he had to deal with a generation of wildlife users who had been indoctrinated with sound thinking regarding wildlife use and production. But, he cannot expect results in this direction unless he himself is ready to support some of the steps necessary to attain such a goal.

He must first make sure that what he wants taught is sound scientifically and economically. He cannot expect teachers to teach information or practice which scientific sources will not sanction. The illustration I have already mentioned is an example. Unfortunately, most states and fish and game administrations cannot recognize and proceed on the basis of scientifically proven information because their support and dependence is so politically controlled that they are not free to speak their own mind. They must have "window dressing" and "ballyhoo" and the spectacular to attract public acclaim. This is too often not possible of support by sound educational endeavor or objective.

The administrator must make sure his ambitions and programs are coordinated with human progress. There are certain inevitable developments facing us in the course of this progress. Many of these may be inimical to the welfare of certain forms of wildlife and to certain long established habits and practices in hunting and fishing. But there is no use in

blindly fighting developments that must come in the interest of human welfare. Those of us, however, who have been facing this battle for some years cannot help but dream about what the results could be and how much of wildlife could have been saved, if engineers and others responsible for these developments had been indoctrinated with the proper fundamentals of wildlife requirements when they were being "educated."

The administrator must not expect support from educational agencies for programs of his own, conducted in his own manner, and under his own technics if such are contrary to recognized pedagogical methods and principles of those states or communities where he expects tc get the work done. He may have to sacrifice some of his pet ideas to accomplish such coordination, but he will have to do that anyway or fail, and he had better accomplish it in the beginning than give up in failure in the end. By proper advanced coordination he will avoid making big investments with little accomplished, and he will no doubt find that those specially trained and skilled to teach are better versed in how to get the job done than he is.

The administrator must recognize that teaching is a science and a skilled profession, and it cannot be done with unskilled and untrained workers. He must therefore bend every effort to assist in attaining respectable standards for such workers and to procure recognition of his subject matter through recognized educational channels.

He must recognize the tremendous pressure that all teachers are under to cover the vast and varied fields of subject matter arising out of our complex life of today. He must help the teacher find ways to coordinate rather than differentiate.

He must recognize that this complexity of activity and life is a problem of not only the teacher but of the child itself and of the parent and of the family. We hear a great deal of discussion about the responsibility of parents for the character of youth, but when one contemplates the maze of school bands, athletics, class organizations, fraternal activities, Red Cross, welfare work, paper salvage drives, and a dozen other demands on the child's time, one wonders when a parent has any time left to exercise his parental obligations or when a child has any time to learn to understand family values.

It is of paramount importance for an administrator with notions of youth education to appreciate his obligation in influencing supporting adult constituency into the proper preachments. There is no use in attempting to train children in proper wildlife appreciation and activity, only to have him run into doubt and ridicule on the part of the adult.

He, the administrator, must realize that he cannot expect educators to propound doctrines and teach practices that simply do not fit into local and national economy. In the wildlife field there is a great deal of worthwhile teaching from the standpoint of the aesthetic and the moral and social reactions of wildlife appreciation. And this part should by no means be overlooked or even relegated to the status of unimportant. But, after all, human beings are interested first in enough material welfare to keep themselves and their families in a reasonably respectable state of happiness. The foundation for all the happiness of the human race is in the land. The fundamental requirement for all wildlife welfare is also in the land. It follows irrefutably, therefore, that any wildlife teaching the administrator is interested in must become a part of the teaching of human economy, properly interrelated.

The administrator must be willing to and capable of putting his teaching material on the level of the child who is to

be taught. His scientific and research staffs must be willing also to get to that level, or at least be able to interpret the fundamentals of their findings on that level. Otherwise the effort is lost.

Well, all of this may sound well enough as a preachment, but can it be done?

I believe it can.

I know of one state where adult psychology has reached the stage where the administrative agency is not compelled to carry a big investment in game farms, where large groups of organized sportsmen with adequate finances are actively engaged in programs of environmental development, where the fundamental tenet of the administration is that all land and all products of land must be considered in building a balanced civilization, and that is why the Conservation Commission allies itself with all other agencies—state, federal and private—that have to do with maintaining the productivity of the land and the welfare of the people.

In that state, it is the fixed policy of the administrative agency that no youth program, literature or instruction materials can go out except they have first been approved by the proper educational agency.

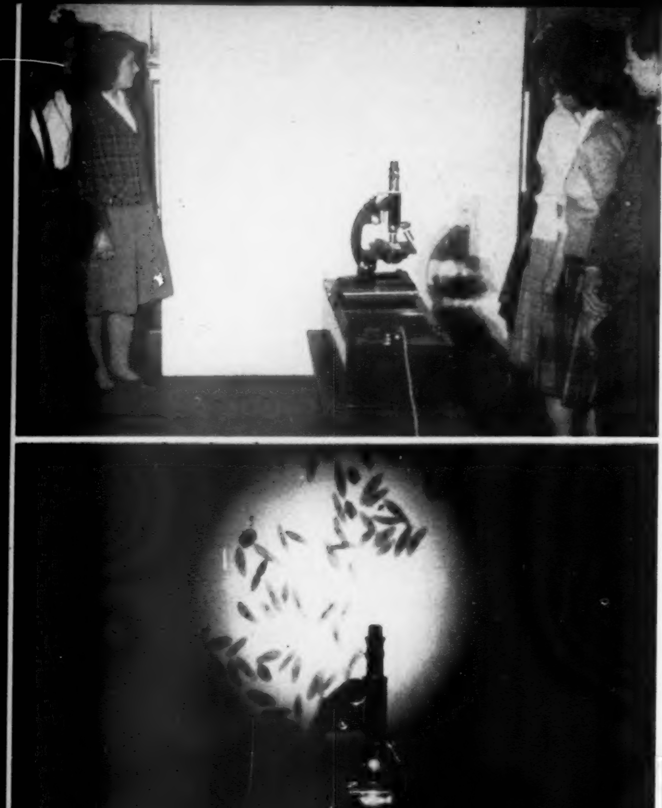
In this state a separate educational section has been established in the administrative agency, with a trained educator in charge, and staffed with people trained as teachers. In this organization the staff of the wildlife administration attends most of the county plan meetings of teachers, where annual teaching programs are being developed. Wildlife conservation has been included in the course-of-study book. To implement the work there has been produced by the administrative agency, approved by a committee of educators from the State Department of Education and the School of Education of the University, a series of teachers leaflets or manuals. The demand for these teaching materials has been tremendous.

But these are only the beginnings. There is much hope in the present tendencies of thinking on the part of both educators and administrators. Certainly in a field that touches the lives and the moral building activities of so many millions of people and with the experience of impoverished nations so pointedly indicating the importance of preserving this heritage for America, we ought all to get our heads together and help youth preserve for itself the heritage of wildlife and the out-of-doors. What would the picture be 25 years from now if all youth received the proper training in biology and wildlife management and if we developed a corps of teachers properly equipped to do that teaching?

There is with us not only a need but one of the greatest challenges I know of for someone in the educational field. It is the job of developing an acceptable program of teaching of practical wildlife management. There have been many attempts made to this end, but none of them have been very successful. Cannot this very group I am speaking to or whatever group of educators should properly interest themselves in this field meet with a group from the Administrator's Association and find a solution? We shall have to do it if our coming generations *see* any wildlife, much less have enough to *use*.

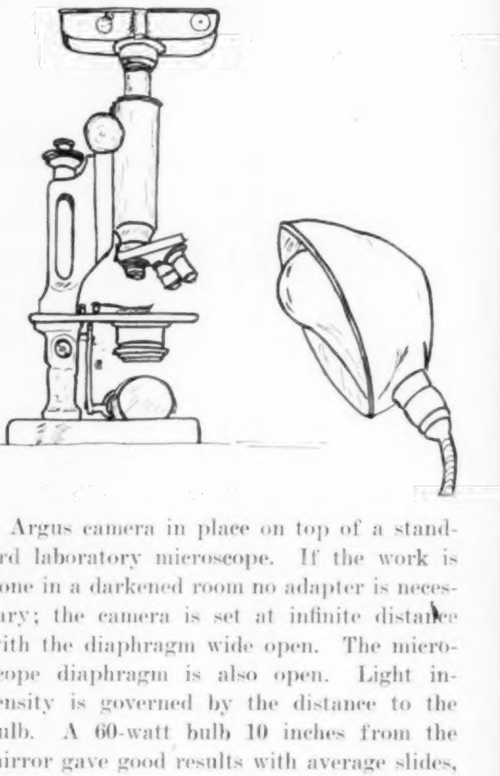
MICROPROJECTION AND MICROPHOTOGRAPHY

During recent months several readers have written to the Editor asking for information and suggestions concerning microprojection or microphotography or both. The Editor has answered these letters, citing various articles that have



Composite photograph made by combining the negatives of the snapshot (upper picture) and the time exposure (middle picture) to show arrangement of a small class observing Paramecia as projected on a screen by a standard micro-projector. *After Exposure—What?* James Perkins Saunders, Nov. 1944, pp. 42–45.

appeared from time to time in *The American Biology Teacher.* On the theory that these letters reflect a general interest, we are printing herewith many of the illustrations that accompanied the articles. Obviously space does not permit the reprinting of the text itself but annotated references to the articles are listed. It is assumed that interested readers can get from these pictures and references some ideas which they can apply; *The American Biology Teacher* will welcome articles or short items describing such applications.



Argus camera in place on top of a standard laboratory microscope. If the work is done in a darkened room no adapter is necessary; the camera is set at infinite distance with the diaphragm wide open. The microscope diaphragm is also open. Light intensity is governed by the distance to the bulb. A 60-watt bulb 10 inches from the mirror gave good results with average slides, using the 16 mm. objective. Both black-and-white and Kodachrome slides were made with this set-up. *Photography Through the Microscope*, Theodore Downs, Nov. 1944, pp. 35–37.

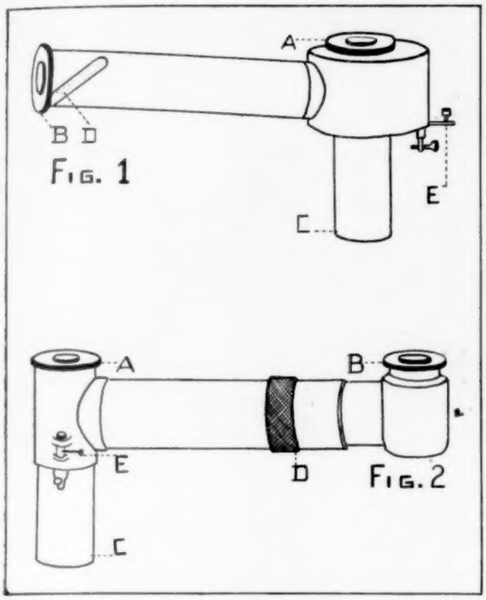
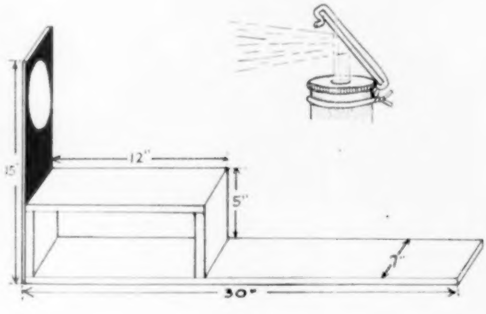


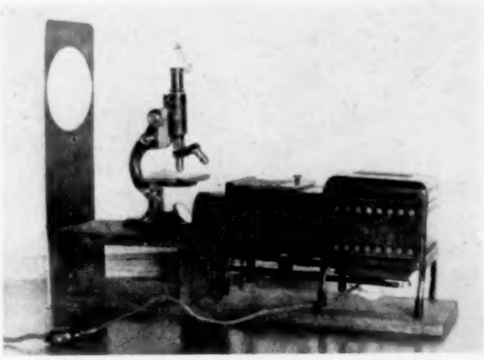
FIGURE 1. One type of demonstration ocular. **A** is the ocular through which the instructor looks. It is in the place of the regular microscope ocular. **B** is the ocular through which the student looks. **C** is the part of the ocular which is placed in the draw tube of the microscope. **D** is a groove along which focusing by the student is regulated (by turning ocular **B**). E is the pointer which extends into the vertical ocular.

FIGURE 2. Another type of demonstration ocular. The letters A, B, C and E represent the same things as in Figure 1. **D** is a collar by which the student focuses ocular **B**. Ocular **B** can be rotated in a complete circle from the vertical position or counter clockwise.

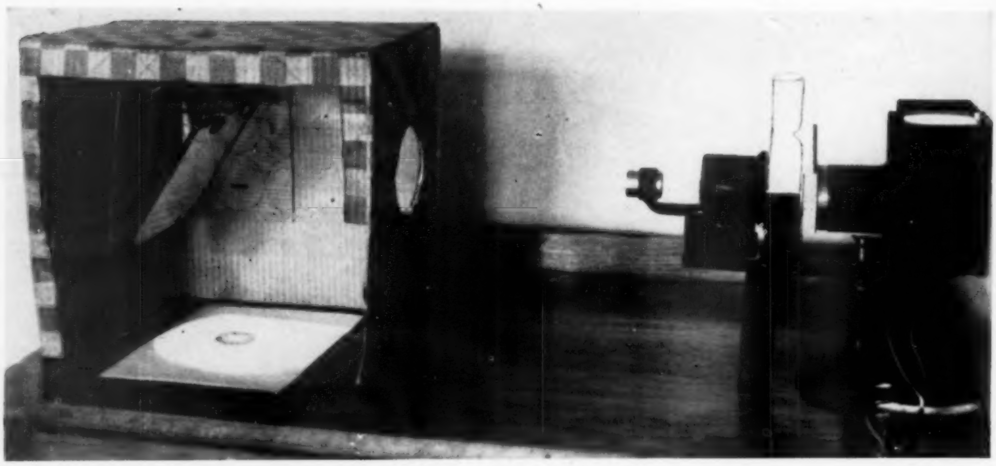
Fig. 3

The demonstration ocular enables the teacher to point out to the pupil a specific item in a microscopic field. It is a convenient accessory or substitute for the projector in cases where only a small number of pupils is involved. *The Demonstration Ocular,* Mary D. Rogick, April 1946, pp. 162–164.

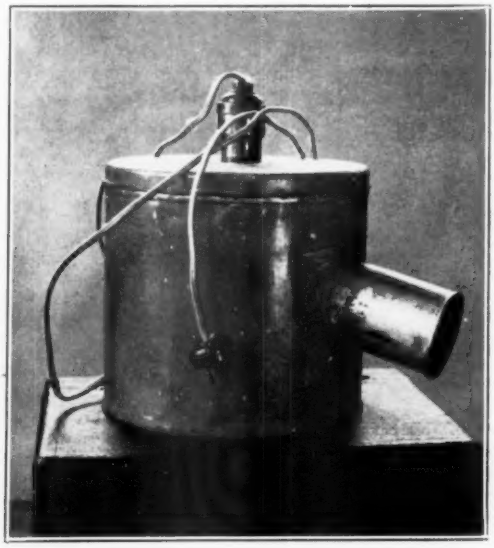




A standard laboratory microscope and a lantern slide projector, with a mirror (a prism would work better) to throw the image on the screen. A coat of white poster paint makes a satisfactory screen. *A Simple Microprojector,* Dempsey J. Snow, Oct. 1943, pp. 10–11.



Projector consisting of a 200 watt lamp, a microprojection attachment for a projection lantern; viewing "cabinet" consisting of a pasteboard carton, dime-store mirror and a drawing-paper screen. *That Students May See*, Brother H. Charles, F.S.C., April 1946, pp. 177–180.



Left: Argus camera attached by means of an adapter to a standard Spencer laboratory microscope. This arrangement enables one to work in a fully lighted room. Right: An illuminator made from two tin cans soldered together. A 60- or 100-watt bulb suspended in the larger can has its rays directed downward by the smaller can soldered over a hole cut in the larger one. *Photography*, Donald S. Lacroix, Nov. 1944, pp. 27–29.

BY THE WAY

WHEN PRESERVING INSECTS in formaldehyde solution or in alcohol, don't forget to add a little glycerin, to prevent legs, wings, antennae, etc., from becoming excessively brittle. The glycerin should be in a strength of about 6 cc. to 100 cc. of total solution.

MERCUROCHROME, IODINE, bluing and cake coloring have been found acceptable for stains for slides; colored inks are generally not satisfactory because they are poorly absorbed and many of them spread into the mounting medium.

FORMALIN is the trade name of a *40% solution* of formaldehyde; a 10% formalin solution is a 4% formaldehyde solution. A 10% formalin solution is very commonly used for preservation of biological specimens; a 10% formaldehyde solution would be much too strong and would render some tissues unduly brittle, not to mention wasting a considerable amount of formaldehyde.

IF CIGAR BOXES are to be used for storing insect collections be sure to select boxes with as tight-fitting lids as possible, and examine frequently for signs of depredations of "museum beetles" and other destructive insects. Flakes of naphthalene or crystals of paradichlorobenzene sprinkled in the bottom of the box will repel most types of destructive insects. However, unless the lids of the boxes are reasonably tight, these chemicals evaporate rather rapidly.

FORMALDEHYDE may be removed from preserved dissection material by immersing the specimens for about five minutes in the following solution:

Sodium bisulphite	60 grams
Sodium sulphite	40 grams
Water to make	1 liter

Do not leave the specimens in this solution because it is not a preservative. Do not use in metal containers because corrosion will result; use glass or stoneware.

TRICHOCYSTS in *Paramecium* may be demonstrated by adding a small drop of iodine solution in alcohol to the culture; if this is not available a drop of blue-black fountain pen ink will usually do the job.

DROSOPHILA for genetics have been mentioned so frequently that it is often forgotten that these little flies are also very useful for a number of other purposes. They serve as excellent demonstrations of complete metamorphosis and since they can be raised easily in large quantities they may be used in winter for food for lizards, toads, etc.

EVERY BIOLOGY ROOM should have a bulletin board for posting clippings, pictures from *Life*, etc. These can be changed frequently and help greatly to stimulate interest. After the first couple of weeks, the pupils will keep the board filled with new material.

MAKE IT AN IRONCLAD RULE to label all specimens intended for the permanent collection; a specimen without data is almost worthless. The name is unimportant (and can be determined at any later date), but each specimen must bear a label showing the date collected and the locality. Habitat notes are also very desirable. *Turtox News,* December, 1945, p. 192.

OPEN A DRY MILK-WEED POD and blow some of the seeds across the room. This stimulating incident will make clear the meaning of the word *prolific* or *prodigality in nature.* The pods may be gathered in the autumn and kept until needed.

A PIECE OF CELLOTEX or other brand of wall-board should be placed in the classroom in a convenient place, for attachment of pictures, clippings, etc., by means of thumb tacks. Encourage the pupils to bring in pictures clipped from magazines, illustrating the topics that are being studied and are assigned for future periods.

As in the past, *The American Biology Teacher* will bring to its readers as much as possible of the Boston meeting. Some of the addresses will be printed in the full, and it is hoped that a fairly complete digest of the entire meeting will be available for printing in the early issues.